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Safety devices for protection against excessive pressure —

Part 6: Application, selection and installation of bursting disc safety devices

Dispositifs de sécurité pour protection contre les pressions excessives —
Partie 6: Application, sélection et installation des dispositifs de sûreté à disque de rupture

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2. www.iso.org/directives

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT), see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 185, *Safety devices for protection against excessive pressure.*

This second edition cancels and replaces the first edition (ISO 4126-6:2003), which has been technically revised.

The main technical modifications are:

a) Revision to Annex C to refer to Part 7 for capacity calculations;

b) Annex D was deleted as this information is found in Part 7;

c) Annex E was revised to include methodology for establishing flow resistance values for bursting discs opened in incompressible fluid;

d) Annex F was added to include existing and additional guidelines for type testing;

e) Annex G was added to provide a place for informative information relative to bursting disc tolerances and operating parameters.

ISO 4126 consists of the following parts, under the general title *Safety devices for protection against excessive pressure*:

— *Part 1: Safety valves*

— *Part 2: Bursting disc safety devices*

— *Part 3: Safety valves and bursting disc safety devices in combination*

— *Part 4: Pilot operated safety valves*

— *Part 5: Controlled safety pressure relief systems (CSPRS)*

— *Part 6: Application, selection and installation of bursting disc safety devices*

— *Part 7: Common data*

— *Part 9: Application and installation of safety devices excluding stand-alone bursting disc safety devices*

— *Part 10: Sizing of safety valves for gas/liquid two-phase flow*

— *Part 11: Performance testing*[1)]

Part 7 contains data, which is common to more than one of the parts of ISO 4126 to avoid unnecessary repetition.

1) In development.

Introduction

Safety devices for the protection of pressure equipment against excessive pressure include pressure relief devices such as safety valves and bursting disc safety devices which, dependent upon the application, may be used either as the sole pressure relieving devices or in conjunction with each other.

Operating problems frequently arise due to the use of pressure relieving devices not having been properly selected for the intended service or properly selected but whose performance is adversely affected by improper handling, wrong installation or lack of maintenance, any of which may affect the safety of the pressure equipment being protected.

It is important to consider not only the pressure relief devices but also the whole of the pressure relief system so as not to reduce the relieving capacity below that required or adversely affect the proper operation of the pressure relieving devices.

A bursting disc safety device is a non-reclosing pressure relief device which typically comprises a bursting disc, which is a pressure-containing and pressure-sensitive part designed to open by bursting at a predetermined pressure, and a bursting disc holder. There are many different types of bursting disc safety devices manufactured in corrosion resistant materials, both metallic and non-metallic, to cover a wide range of nominal sizes, burst pressures and temperatures. They are used to protect pressure equipment such as vessels, piping, gas cylinders or other enclosures from excessive pressure and/or excessive vacuum.

This standard covers the important considerations necessary in the application, selection and installation of bursting disc safety devices to give the required protection against excessive pressure and/or excessive vacuum.

Safety devices for protection against excessive pressure —

Part 6:
Application, selection and installation of bursting disc safety devices

1 Scope

This International standard gives guidance on the application, selection and installation of bursting disc safety devices used to protect pressure equipment from excessive pressure and/or excessive vacuum.

Annex A provides a checklist for the information to be supplied by the purchaser to the manufacturer.

Annex B gives guidance on the replacement period of a bursting disc.

Annex C provides guidance for determining the discharge capacity, for single phase fluids, of a pressure relief system that contains a bursting disc safety device.

Annex D is a non-mandatory procedure for establishing the flow resistance of a burst bursting disc assembly.

Annex E is a non-mandatory procedure for type testing of bursting disc safety devices.

Annex F provides typical performance characteristics for various bursting disc safety device types.

The requirements for the manufacture, inspection, testing, marking, certification and packaging of bursting disc safety devices are given in ISO 4126-2.

2 Normative references

The following referenced documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 4126-2, *Safety devices for protection against excessive pressure — Part 2: Bursting disc safety devices*

ISO 4126-3, *Safety devices for protection against excessive pressure — Part 3: Safety valves and bursting disc safety devices in combination*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 4126-2 and the following apply.

3.1
bursting disc safety device
non-reclosing pressure relief device actuated by differential pressure and designed to function by the bursting of the bursting disc(s), and which is the complete assembly of installed components including, where appropriate, the bursting disc holder

3.2
bursting disc assembly
complete assembly of components, which are installed in the bursting disc holder to perform the desired function

3.3
bursting disc
pressure-containing and pressure-sensitive component of a bursting disc safety device

3.4
bursting disc holder
that part of a bursting disc safety device, which retains the bursting disc assembly in position

3.5
conventional domed bursting disc (also referred to as, forward acting)
bursting disc which is domed in the direction of the bursting pressure (i.e. where the bursting pressure is applied to the concave side of the bursting disc

Note 1 to entry: See ISO 4126-2:2003, Figure 1).

3.6
slotted lined bursting disc
bursting disc made up of two or more layers, at least one of which is slit or slotted to control the bursting pressure of the bursting disc

3.7
reverse domed bursting disc (also referred to as, reverse acting)
bursting disc which is domed against the direction of the bursting pressure (i.e. where the bursting pressure is applied to the convex side of the bursting disc

Note 1 to entry: See ISO 4126-2:2003, Figure 2).

3.8
flat bursting disc
bursting disc having one or more layers which is flat when installed. It may be made of a ductile or brittle material

3.9
graphite bursting disc
bursting disc manufactured from graphite, impregnated graphite, flexible graphite or graphite composite and designed to burst due to bending or shearing forces

3.10
specified bursting pressure
bursting pressure quoted with a coincident temperature when defining the bursting disc requirements (used in conjunction with a performance tolerance, see 3.14)

3.11
specified maximum bursting pressure
maximum bursting pressure quoted with the coincident temperature when defining the bursting disc requirements (used in conjunction with specified minimum bursting pressure, see 3.12)

3.12
specified minimum bursting pressure
minimum bursting pressure quoted with the coincident temperature when defining the bursting disc requirements (used in conjunction with specified maximum bursting pressure, see 3.11)

3.13
coincident temperature
temperature of the bursting disc associated with a bursting pressure (see 3.10, 3.11 and 3.12) and which is the expected temperature of the bursting disc when it is required to burst

3.14
performance tolerance
range of pressure between the specified minimum bursting pressure and the specified maximum bursting pressure or the range of pressure in positive and negative percentages or quantities which is related to the specified bursting pressure

3.15
operating pressure
pressure existing at normal operating conditions within the system being protected

3.16
relieving pressure
maximum pressure under discharge conditions in the pressurized system

Note 1 to entry: It can differ from the bursting pressure of the bursting disc.

3.17
relieving temperature
temperature under discharge conditions in the pressurized system

Note 1 to entry: It can differ from the coincident temperature specified for the bursting disc.

3.18
differential back pressure
differential pressure across a bursting disc in the opposite direction to the direction of the bursting pressure, which is the result of pressure in the discharge system from other sources and/or a result of vacuum on the upstream side of the bursting disc

3.19
vent area
cross-section area available for discharge of fluid as calculated by the manufacturer

Note 1 to entry: The calculated vent area should not exceed the cross-sectional area of the upstream piping, A_1.

3.20
batch
quantity of bursting discs or bursting disc safety devices made as a single group of the same type, size, materials and specified bursting pressure requirements where the bursting discs are manufactured from the same lot of material

3.21
bursting pressure
value of the differential pressure between the upstream side and the downstream side of the bursting disc when it bursts

3.22
stiffening ring
component of a bursting disc assembly used primarily for reinforcing bursting discs

3.23
back pressure support
component of a bursting disc safety device, which prevents damage to the bursting disc due to differential back pressure

Note 1 to entry: A back pressure support, which is intended to prevent damage to the bursting disc when the system pressure falls below atmospheric pressure, is sometimes referred to as a vacuum support.

3.24
coating
layer of metallic or non-metallic material applied to components of a bursting disc safety device by a coating process

3.25
lining
additional sheet or sheets of metallic or non-metallic material forming part of a bursting disc assembly or bursting disc holder

3.26
plating
metal layer applied to a bursting disc or bursting disc holder by a plating process

3.27
temperature shield
device which protects a bursting disc from excessive temperature

3.28
operating ratio
ratio between the operating pressure and the minimum limit of bursting pressure

Note 1 to entry: See Figure 1.

Note 2 to entry: In the case of a pressure system with an operating pressure expressed in bar gauge and atmospheric pressure on the downstream side of the bursting disc:

$$\text{Operating ratio} = \frac{\text{operating pressure (bar)}}{\text{minimum limit of bursting pressure (bar)}}$$

Note 3 to entry: In the case of a pressure system with a back pressure on the downstream side of the bursting disc, the operating ratio is the value of the differential pressure between the upstream side and the downstream side of the bursting disc divided by the minimum limit of bursting pressure expressed as a differential pressure.

3.29
bursting disc safety device discharge capacity
rate at which a bursting disc safety device can discharge fluid after bursting of the bursting disc

3.30
replacement period
time period beginning at the installation of a bursting disc assembly and ending at replacement

3.31
pressure relief system
system intended for the safe relief of fluids from pressure equipment for prevention of excessive pressure

Note 1 to entry: It can consist of equipment nozzle, inlet piping, pressure relief device(s) and discharge piping to atmosphere/collecting vessel/header.

3.32
discharge coefficient
coefficient which determines reduction of theoretical discharge capacity of a pressure relief system by the simplified approach (see C.2) which incorporates a burst bursting disc, forming part of a bursting disc safety device

Note 1 to entry: It is denoted by the symbol α.

3.33
flow resistance factor
K_R
dimensionless expression of the velocity head loss attributed to the presence of a bursting disc safety device in a piping system

3.33.1
flow resistance factor
K_{RG}
flow resistance of a bursting disc safety device when burst with compressible fluid in contact with the upstream side of the bursting disc

3.33.2
flow resistance factor
K_{RL}
flow resistance of a bursting disc safety device when burst with incompressible fluid in contact with the upstream side of the bursting disc

3.33.3
flow resistance factor
K_{RGL}
flow resistance of a bursting disc safety device when burst with either compressible or incompressible fluid in contact with the upstream side of the bursting disc

3.34
base pressure
pressure recorded at the pipe inlet of the bursting disc flow test system

3.35
base temperature
temperature recorded at the pipe inlet of the bursting disc flow test system

3.36
maximum allowable pressure
p_S
maximum pressure for which the equipment is designed, as specified by the manufacturer

3.37
non-fragmenting bursting disc safety device
bursting disc safety device that is designed to retain the petals produced during activation

4 Symbols and units

Table 1 — Symbols and their descriptions

Symbol	Description	Units
A_o	Required minimum cross-sectional flow area	mm^2
A_1	Cross-sectional area of upstream piping	mm^2
A_B	Bursting disc safety device vent area	mm^2
C	Function of the isentropic exponent	—
C_{tap}	Sonic velocity at pressure tap	m/s
D	Test system pipework inside diameter	mm
f	Fanning friction for system, pipe	—
G	Mass velocity	$kg/(m^2 \cdot h)$
k	Isentropic exponent	—
K_b	Theoretical capacity correction factor for subcritical flow	—
K_v	Viscosity correction factor	—
K_R	Flow resistance factor	—

[a] x is expressed as 0,xx.

Table 1 *(continued)*

Symbol	Description	Units
K_{tap}	Total resistance factor from pipe inlet of test system to pressure tap	—
M	Molecular mass	kg/kmol
Ma_{tap}	Mach number at pressure tap	—
Ma_1	Mach number at pipe inlet of test system	—
p_1	Test system pipe inlet pressure	bar abs.
p_B	Base pressure	bar abs.
p_b	Back pressure	bar abs.
p_c	Critical pressure	bar abs.
p_o	Relieving pressure	bar abs.
p_{tap}	Pressure at pressure tap	bar abs.
p_r	Reduced pressure	—
Q_m	Mass flow rate	kg/h
R	Universal gas constant	8 314 J·kmol^{-1}·K^{-1}
Re	Reynolds Number	—
T_B	Base temperature	K
T_o	Relieving temperature	K
T_{tap}	Temperature recorded at pressure tap	K
T_1	Test system pipe inlet temperature	K
v_o	Specific volume at actual relieving pressure and temperature	m^3/kg
v_{tap}	Specific volume at pressure tap	m^3/kg
x[a]	Dryness of wet steam	—
Y_{tap}	Expansion factor at pressure tap	—
Y_1	Expansion factor at pipe inlet of test system	—
Z_o	Compressibility factor at actual relieving pressure and temperature	—
ρ	Density	kg/m^3
μ	Dynamic viscosity	Pa·s
Δp	Differential pressure on venting across bursting disc safety device	bar abs.
α	Discharge coefficient (see C.2)	—

[a] x is expressed as 0,xx.

5 Application

5.1 Subject to the requirements of the relevant standard covering the equipment to be protected, bursting disc safety devices may be used either as the sole pressure relieving device, in conjunction with safety valves or as part of a combination device.

5.2 The discharge capacity of a system including a bursting disc safety device and its maximum limit of bursting pressure (see Figure 1) at the coincident temperature shall be such that the maximum relieving pressure does not exceed the requirements of the protected equipment. Annex C gives methods for determining discharge capacity of pressure relief systems incorporating bursting disc safety devices.

5.3 The use of a bursting disc safety device as the sole pressure relieving device may be preferred in the following cases where:

a) the rate of increase in pressure may be such that the rate of response of a safety valve would make it unsuitable;

b) leakage of the fluid cannot be tolerated under operating conditions;

c) operating conditions may involve deposition, which would make a safety valve inoperative;

d) the effect of low temperature would prevent a safety valve from operating;

e) large discharge areas are required.

NOTE A bursting disc safety device is a non-reclosing pressure relieving device, which after bursting could result in the total loss of pressure/contents from the protected equipment.

5.4 For all applications the pressure relief system shall be such that following the bursting of the bursting disc assembly any fragmentation or release of material does not:

a) cause an unacceptable flow restriction within the pressure relief system;

b) impair the proper functioning of any other safety device;

c) affect the certified (discharge) capacity of any other safety device.

5.5 Bursting disc safety devices may be used in association with safety valves, pilot operated safety valves or CSPRS (according to ISO 4126-1, ISO 4126-4 and ISO 4126-5 respectively) as permitted by the relevant standard. The application of the bursting disc safety devices shall not result in excessive pressure in the protected equipment.

5.5.1 Bursting disc safety devices in conjunction with safety valve(s) may be used in the following cases:

a) in series, to protect the safety valve against corrosion, fouling or operating conditions which may affect the safety valve performance;

b) in series, to prevent leakage;

c) in series, to prevent total loss of contents from the protected equipment following the bursting of the bursting disc;

d) in parallel, as an additional safeguard.

5.5.2 Where a bursting disc safety device is to be installed upstream of a safety valve the following requirements shall be met:

a) the space between the bursting disc safety device and the safety valve shall be provided with an appropriate means to prevent or detect an unacceptable build up in pressure;

b) the bursting disc safety device shall be a non-fragmenting design;

c) the nominal pipe size of the bursting disc safety device shall be not less than the nominal size of the inlet of the safety valve;

d) where the bursting disc safety device is within 5 pipe diameters, see ISO 4126-3.

e) where the bursting disc safety device is beyond 5 pipe diameters of the safety valve consult the manufacturer for application guidance.

NOTE Bursting discs, being pressure differential devices, will require a higher pressure in the protected equipment to burst the bursting disc if pressure builds up in the space between the bursting disc and the safety valve which will occur should leakage develop in the bursting disc due to corrosion, or due to back pressure in the discharge piping or other cause.